DEVICE FOR TREATING FORAGE AND AGRICULTURAL MOWER WHICH USES A SUCH DEVICE FOR TREATING FORAGE.

The present invention relates to a device for treating forage comprising a rotor driven in rotation about an axis, which rotor consists of a support and of at least one conditioning element, the said conditioning element comprising at least one active part intended to work the forage and a first connecting part intended to connect the said conditioning element to the said support by means of a first connection.

When making hay, the cut grass needs to be completely dried prior to storage in order for the forage to keep well. Forage treatment devices, also called conditioners, advantageously make it possible to reduce the time needed for such drying. What these devices actually do is act mechanically to break up the film of wax which envelopes the stalks of the forage. This breaking-up encourages a rapid dissipation of the moisture contained in the plant.

Document **FR 2 440 145** describes a mower comprising a cutting mechanism intended to cut a standing product, for example grass. To do this, the said cutting mechanism has four discs arranged in a transverse line of the said mower and driven in rotation about a respective vertical axis.

This known mower also comprises a treatment device intended to reduce the time taken for the cut forage to dry. To do this, the said forage treatment device comprises a rotor arranged behind the said discs and driven in rotation about a horizontal axis. This rotor consists of conditioning elements and of a support. Each conditioning element comprises, at one of its ends, a connecting part. The connecting part allows the corresponding conditioning element to be connected pivotally to the said support by means of an articulation the axis of which is parallel to the axis

of rotation of the said rotor. Because of the centrifugal force generated by the rotation of the said support, the conditioning element during work extends in a substantially radial direction.

Thus, during work, the forage coming from the cutting mechanism is carried, by an active part of the conditioning element, along a conditioning sheet to finally be ejected to the rear of the said mower. The passage of the forage against the said conditioning sheet causes a breaking-up of the stalks of the forage that encourages rapid drying of the latter.

The brochure **"Faucheuses-Conditionneuses frontales FC 280F / FC 313F Lift Control"** [Front-mounted mower-conditioners FC 280F/FC 313F - lift control] published by the Applicant company, discloses another mower equipped with a forage treatment device. In that document, the said forage treatment device also comprises a rotor driven in rotation about a horizontal axis. This rotor consists of a support and of V-shaped conditioning elements. Each conditioning element this time is connected rigidly to the said support by a central connecting part. The two ends of the V-shape extend in a radial position to form an active part.

During work, the rotational frequency of such rotors is generally between 600 and 1 000 revolutions per minute. As a result, if the connection between the support and the conditioning element should break, the latter element is ejected from the rotor violently by the centrifugal force. The conditioning element thus ejected constitutes a projectile travelling at relatively high speed. This projectile may damage other parts of the forage treatment device, particularly the conditioning sheet. Of far greater concern, such a projectile may also be dangerous to anybody close to the forage treatment device.

The object of the present invention is to avoid a conditioning element being able to cause damage or injury should the first connection connecting the said conditioning element to the said support break.

To this end, the forage treatment device according to the present invention is characterized in that a second connection is provided, this being intended to connect the said conditioning element to the said support should the said first connection break.

Should the said first connection break, the said second connection advantageously makes it possible to maintain a connection between the said conditioning element and the said support. Thus, the said conditioning element will not be ejected from the rotor. The risks of damage and injury are therefore eliminated.

Other features of the invention, to be considered separately or in all possible combinations, will become further apparent from the following description of some non-limiting exemplary embodiments of the invention that are depicted in the appended drawings in which:

- Figure 1 depicts, viewed from above, an agricultural mower according to the present invention;
- Figure 2 depicts, viewed from the side in the direction of arrow II defined in Figure 1, and to a different scale, the agricultural mower of Figure 1;
- Figure 3 depicts a view in section, in the direction of arrow III defined in Figure 1, and to a different scale, of a rotor according to the present invention;
- Figure 4 depicts, to a different scale, a conditioning element of the rotor of Figure 3;

- Figure 5 depicts, viewed from the side in the direction of arrow V defined in Figure 4, the conditioning element of Figure 4;
- Figure 6 depicts, viewed in the direction of arrow VI defined in Figure 3, and to a different scale, a portion of the surface of the tube of Figure 3;
- Figure 7 depicts, viewed from the front in the direction of arrow VII defined in Figure 2, a part view of another rotor according to the present invention; and
- Figure 8 depicts, viewed from the side in the direction of arrow VIII defined in Figure 7, and to a different scale, the rotor of Figure 7.

Figure 1 depicts, in a view from above, an agricultural mower (1) according to the present invention. The said mower (1) is hitched to a motor vehicle (2) which pulls it in a sense and direction of forward travel indicated by the arrow (3). In the remainder of the description, the ideas of "front" and "rear", "in front of" and "behind" are defined with respect to the direction of forward travel and the ideas of "right" and "left" are defined when viewing the said mower (1) from behind in the direction of forward travel (3).

In a way known to those skilled in the art, the said mower (1) comprises a chassis (4) which rests on the ground (12) by means of two wheels (5). The said chassis (4) is connected to the rear end of a drawbar (6) by means of a central articulation (7) of substantially vertical axis (7a). For its part, the front end of the said drawbar (6) is connected to the lower hitching bars (8) of the said motor vehicle (2).

In the exemplary embodiment depicted in Figure 1, the said mower (1) is arranged substantially in the continuation of the said motor vehicle (2). This

configuration is used when the said mower (1) is being transported. During work, the said central articulation (7) allows said mower (1) to be offset to the right or to the left of the said motor vehicle (2) by means of a ram (9). The said mower (1) can thus advantageously operate back and forth.

In a way also known to those skilled in the art, the said mower (1) additionally comprises a mowing unit (10) connected to the said chassis (4) by means of a suspension (11). The said suspension (11) allows the said mowing unit (10) to follow unevennesses of the ground (12) independently of the said chassis (4). Advantageously, the said suspension (11) also allows at least some of the weight of the said mowing unit (10) to be transferred onto the said chassis (4). The said mowing unit (10) is made up of a cutting mechanism (13) and of a forage treatment device (14).

The said cutting mechanism (13) is intended to cut a standing product, for example grass. To do this, the said cutting mechanism (13) comprises several cutting members (15) driven in rotation about a respective substantially vertical axis. The said cutting members (15), depicted symbolically in Figure 1, are advantageously arranged in a line transversal to the said direction of forward travel (3).

As illustrated in Figure 2, each cutting member (15) supports two cutting elements (16). During work, the said cutting elements (16), also called knives, describe circles in a substantially horizontal plane. The relatively high speed of movement of the said cutting elements (16), due essentially to the rotation of the said cutting members (15), allows the said standing product to be cut.

For its part, the said forage treatment device (14) is intended to accelerate the drying of the product cut by

the said cutting mechanism (13). To do this, the said forage treatment device (14) comprises a rotor (17) driven in rotation about an axis (17a) that is substantially horizontal and transversal to the said direction of forward travel (3). The direction in which the said rotor (17) rotates is indicated on Figures 2 and 3 by the arrow (18).

During work, the said rotor (17) carries the forage coming from the said cutting mechanism (13) along a conditioning sheet. The passage of the forage against the said conditioning sheet causes breaking-up that encourages rapid drying of the cut product. As the said conditioning sheet is within the competence of the person skilled in the art, it has therefore not been depicted in the figures.

In a way known to those skilled in the art, the said mower (1) also comprises transmission elements intended to transmit rotational movement from a power take-off of the said motor vehicle (2) as far as the said cutting elements (16) and the said rotor (17). These transmission elements are, in particular, telescopic shafts with universal joints (19), gearboxes (20), pulleys (21) and belts (22).

Certain elements of the said mower (1) have been depicted only partially in Figures 1 and 2 in order to make the present invention easier to understand.

In order to carry the forage effectively along, the said rotor (17) consists of a support (24) and of at least one conditioning element (23). Indeed, each conditioning element (23) is provided with an active part (26) which, during work, extends in an at least substantially radial direction with respect to the said axis of rotation (17a). The said active parts (26) thus act like clutches to drive the forage along the said conditioning sheet. Each conditioning element (23) also

comprises a first connecting part (27) intended to connect the said conditioning element (23) to the said support (24) by means of a first connection.

In the first exemplary embodiment depicted in Figures 1 to 6, the said first connection pivotally connects the said conditioning element (23) to the said support (24). By contrast, in the second exemplary embodiment depicted in Figures 7 and 8, the said first connection rigidly connects the said conditioning element (123) to the said support (124). The second exemplary embodiment will be described in greater detail later on.

In the first exemplary embodiment, the said first connection is achieved by means of an articulation (28) of the pivot type and of axis (28a). As a preference, the axis (28a) of the said articulation (28) is at least substantially parallel to the axis of rotation (17a) of the said rotor (17). Should an obstacle be encountered, the said active part (26) of the said conditioning element (23) can advantageously retract, pivoting backwards with respect to the direction of rotation (18) of the said rotor (17).

More specifically and as depicted in Figure 3, the said first connecting part (27) of the said conditioning element (23) has a cylindrical shape of longitudinal axis (27a). For its part, the said support (24) comprises at least one connecting element (25) equipped with a mark of a shape that complements the cylindrical shape of the said first connecting part (27). The said support (24) also consists of a tube (38) the longitudinal axis of which is coincident with the axis of rotation (17a) of the said rotor (17). The said connecting element (25) is fixed to the surface of the said tube (38), advantageously removably. When this exemplary embodiment of the said rotor (17) is being assembled, the cylindrical shape of the said first connecting part (27) sits in the mark of the said

connecting element (25) so as to achieve the said articulation (28). Advantageously, the axis (27a) of the said connecting part (27) is at least substantially coincident with the axis (28a) of the said articulation (28).

In the exemplary embodiment depicted more specifically in Figures 4 and 5, the said active part (26) of the said conditioning elements (23) comprises two substantially identical fingers (33). The said fingers (33) are offset one with respect to the other in a direction substantially parallel to the longitudinal axis (27a) of the said connecting part (27), while at the same time remaining substantially mutually parallel. In addition, the said fingers (33) are substantially perpendicular to the longitudinal axis (27a) of the said connecting part (27). The said fingers (33) are also curved slightly so as to be able easily to release the forage after the passage of the said conditioning sheet.

Each end of the said cylindrical shape (27) extends as far as a respective finger (33). The said active part (26) and the said connecting part (27) thus substantially form a U. The said conditioning element (23) therefore is at no risk of excessive translational movement with respect to the corresponding said connecting element (25) along the axis (28a) of the said articulation (28).

According to an important feature of the present invention, a second connection is provided, this being intended to connect the said conditioning element (23) to the said support (24) should the said first connection break.

In the first embodiment, should the said first connection break, the said second connection takes place more precisely between the said conditioning

element (23) and the said tube (38). As a preference, the said second connection takes place between a second connecting part (29) of the said conditioning element (23) and the said tube (38).

To achieve this, and as shown by Figures 4 and 5, the said second connecting part (29) comprises a body (51) and a head (52). The said body (51) is connected to the said first connecting part (27) and the said head (52) is advantageously distant from the said axis (27a) of the said first connecting part (27). In addition, the width (55) of the said head (52), viewed along the said axis (27a) exceeds the width (53) of the said body (51). As a preference, the said second connecting part (29) extends at least substantially at right angles to the said first connecting part (27). In the exemplary embodiment depicted in Figures 4 and 5, the said head (52) is produced by means of an elastically deformable element inserted transversely into the said body (51). According to another not depicted exemplary embodiment, the said body (51) and the said head (52) are made of one and the same piece.

Advantageously, the said second connecting part (29) extends at least partially into the said tube (38). The said second connecting part (29) is thus protected, particularly against repeated contact with the cut product. To do this, in the first exemplary embodiment depicted more specifically in Figure 6, the surface of the said tube (38) has at least one notch (50). The said notch (50) is made up of an entry area (56) of which the width (57), viewed along the said axis of rotation (17a), is greater than or equal to the said width (55) of the said head (52). The said entry area (56) allows the said second connecting part (29) to be introduced at least partially into the said tube (38). The said notch (50) also comprises a holding area (58) the width (59) of which, viewed along the said axis of rotation (17a), is less than the said width (55) of the

said head (52) but greater than or equal to the said width (53) of the said body (51). The said holding area (58) of the said tube (38) is intended to collaborate with the said second connecting part (29) of the said conditioning element (23) so as to produce the said second connection. The said notch (50) preferably extends in a plane at least substantially perpendicular to the said axis of rotation (17a). In addition, when viewed in the direction of rotation (18) of the said support (24), the said entry area (56) is advantageously arranged forward of the said holding area (58).

In order to make the present invention easier to understand, the sectioned view of the said rotor (17), depicted in Figure 3, comprises just two conditioning elements (23) connected to the said tube (38) by means of a respective connecting element (25).

The conditioning element (23) situated to the left in Figure 3 is depicted in the normal work position. The said conditioning element (23) is therefore connected to the said support (24) by means of the said first connection. The said head (52) of the said second connecting part (29) is not in contact with the said tube (38). The said second connection is therefore without effect.

By contrast, the conditioning element (23) situated to the right in Figure 3 is depicted following breakage of the said first connection. The said head (52) comes into contact with the interior surface of the said tube (38). As the width (59) of the said holding area (58) is less than the width (55) of the said head (52), the said conditioning element (23) will therefore not be ejected from the said support (24). Any excessive movement, in directions other than the radial direction, of the said conditioning element (23) with respect to the said support (24) is eliminated by

contact between the said body (51) and the edges of the said holding area (58). The said conditioning element (23) situated to the right is therefore connected to the said support (24) by means of the said second connection.

As one of the possible causes of breakage of the said first connection is breakage of the said connecting element (25), the connecting element (25) situated to the right in Figure 3 is depicted only in part in order to symbolize this breakage.

The plane of section in which Figure 3 is depicted passes through two notches (50) so that these can be seen. By contrast, for reasons of clarity, the corresponding said connecting element (25) and the corresponding said conditioning element (23) have not been sectioned in Figure 3.

Figures 7 and 8 depict a second exemplary embodiment of a rotor (117) according to the present invention. This rotor (117) has a certain number of elements which were described earlier. These elements will therefore keep the same reference numeral and will not be described again. It also has a certain number of elements which are comparable with elements of the rotor (17) described earlier. These elements will be given the same reference numeral as the comparable elements of the rotor (17), but increased by 100. They will be described only where necessary.

The said rotor (117) depicted in Figures 7 and 8 may advantageously be mounted on the said mower (1) in place of the said rotor (17) depicted in particular in Figures 1 and 2. Thus, the said rotor (117) is also driven in rotation about an axis (117a) that is substantially horizontal and transversal to the said direction of forward travel (3).

In the second exemplary embodiment depicted in Figures 7 and 8, the said rotor (117) also comprises a support (124) and at least one conditioning element (123). As Figure 7 shows, the said conditioning element (123) is V-shaped. The two fingers (133) of the V-shape extend, during work, in an at least substantially radial direction with respect to the said axis of rotation (117a). The said fingers (133) thus form an active part (126). The central part of the said conditioning element (123) constitutes a first connecting part (127) intended to connect the said conditioning element (123) to the said support (124) by means of a first connection.

By contrast, in the second exemplary embodiment, the said first connection rigidly connects the said conditioning element (123) to the said support (124). As a preference, the said conditioning element (123) is connected rigidly but removably to the said support (124) by the said first connection.

More specifically and in the light of Figures 7 and 8, the said first connecting part (127) of the said conditioning element (123) has a relatively flat shape. For its part, the said support (124) comprises at least one connecting element (125) also equipped with a relatively flat part. A screw (60) allows the said first connecting part (127) to be pressed firmly against the said connecting element (125) so as to make the said first connection. The said support (124) additionally consists of a tube (138) the longitudinal axis of which is coincident with the axis of rotation (117a) of the said rotor (117). This time, the said connecting element (125) is fixed to the surface of the said tube (138) by welding, for example, so as not to be removable.

According to an important feature of the present invention, a second connection is provided, this being

intended to connect the said conditioning element (123) to the said support (124) should the said first connection break.

In the second exemplary embodiment, should the said first connection break, the said second connection is made more specifically between the said conditioning element (123) and the said connecting element (125). As a preference, the said second connection is made between a second connecting part (129) of the said conditioning element (123) and the said connecting element (125).

To achieve this and in the light of Figure 7, the said second connecting part (129) has two lugs (61). Each lug (61) has a branch directed radially towards the said axis of rotation (117a) and a branch directed along the said axis of rotation (117a). The said lugs (61) are advantageously directed towards one another so that, when viewed along the said axis of rotation (117a), the distance separating the said lugs (61) involves a narrowing.

For its part, the said support (125) has an entry area (156) allowing the said second connecting part (129) to pass the narrowing. The said support (125) also comprises a holding area (158) intended to collaborate with the said lugs (61) of the said conditioning element (123) so as to produce the said second connection. Viewed in the direction of rotation (18) of the said support (124), the said entry area (156) is advantageously arranged forward of the said holding area (158).

In order to make the present invention easier to understand, Figure 8 depicts only two conditioning elements (123) connected to the said respective connecting element (125).

The conditioning element (123) situated to the left in Figure 8 is depicted in the normal work position. Said conditioning element (123) is therefore connected to the said support (124) by means of the said first connection. The said lugs (61) of the said second connecting part (129) are not in contact with the said holding area (158). The said second connection is therefore without effect.

By contrast, the conditioning element (123) situated to the right in Figure 8 is depicted following breakage of the said first connection. As the said conditioning element (123) is driven by centrifugal force, the said lugs (61) therefore come into contact with the said holding area (158). As shown by Figure 7, since the width of the said holding area (158) is greater than the said narrowing between the said lugs (61), the said conditioning element (123) will therefore not be ejected from the said support (124). The said conditioning element (123) situated to the right in Figure 8 is thus connected to the said support (124) by means of the said second connection.

As a preference, when the said lugs (61) are in contact with the said holding area (158), the said narrowing between the said lugs (61) is situated outside of the said entry area (156). This is particularly visible in the right-hand part of Figure 8. Thus, should the said first connection break, there is no risk of the said second connecting part (129) crossing the said entry area (156). The said second connection is therefore perfectly safe.

The mower (1), the forage treatment device (14) and the rotors (17; 117) which have just been described are merely exemplary embodiments which must not in any way be taken to limit the field of protection defined by the claims which follow.

Indeed, the forage treatment device (14) according to the present invention may also be fitted to an agricultural machine that has no cutting mechanism (13). Such an agricultural machine is intended merely to treat a product, which has been cut by another machine.